

# **EXHIBIT A-2**

## **MICROELECTRONIC INNOVATIONS L.L.C.’S INFRINGEMENT ANALYSIS**

### **U.S. Patent No. 7,130,594 – Qorvo, Inc.**

#### **Claim 1**

Microelectronic Innovations L.L.C. (“MEI”) provides evidence of infringement of claim 1 of U.S. Patent No. 7,130,594 (hereinafter “the ’594 patent”) by Qorvo, Inc. (“Qorvo”). In support thereof, MEI provides the following claim chart.

“Accused Instrumentalities” as used herein refers to at least the Qorvo 85-4200 MHz Wideband Synthesizer/VCO with Integrated 6 GHz RF Mixer including, but not limited to, the exemplary RFFC5072 product and other systems and products having similar claimed circuitry, that Qorvo makes, uses, imports, offers for sale, and sells to its customers causing them to use the infringing products. The claim chart demonstrates Qorvo’s infringement and provides notice of such infringement, by comparing each element of the asserted claim to corresponding components, aspects, and/or features of the Accused Instrumentalities. The claim chart is not intended to constitute an expert report on infringement. The claim chart includes information provided by way of example, and not by way of limitation.

The analysis set forth below is based only upon information from publicly available resources regarding the Accused Instrumentalities, as Qorvo has not yet provided any non-public information. An analysis of Qorvo’s (or other third parties’) technical documentation and/or software source code may assist in fully identifying all infringing features and functionality. Accordingly, MEI reserves the right to supplement this infringement analysis once such information is made available to MEI. Furthermore, MEI reserves the right to revise this infringement analysis, as appropriate, upon issuance of a court order construing any terms recited in the asserted claims.

MEI provides this evidence of infringement and related analysis without the benefit of claim construction or expert reports or discovery. MEI reserves the right to supplement, amend or otherwise modify this analysis and/or evidence based on any such claim construction or expert reports or discovery.

Unless otherwise noted, MEI contends that Qorvo directly infringes the ’594 patent in violation of 35 U.S.C. § 271(a) by selling, offering to sell, making, using, and/or importing the Accused Instrumentalities. The following exemplary analysis demonstrates that infringement.

Unless otherwise noted, MEI believes and contends that each element of each claim asserted herein is literally met through Qorvo’s provision of the Accused Instrumentalities. However, to the extent that Qorvo attempts to allege that any asserted claim element is not literally met, MEI believes and contends that such elements are met under the doctrine of equivalents. More specifically, in its investigation and analysis of the Accused Instrumentalities, MEI did not identify any substantial differences between the elements of the patent claims and the corresponding features of the Accused Instrumentalities, as set forth herein. In each instance, the identified feature of the Accused

## **MICROELECTRONIC INNOVATIONS L.L.C'S INFRINGEMENT ANALYSIS**

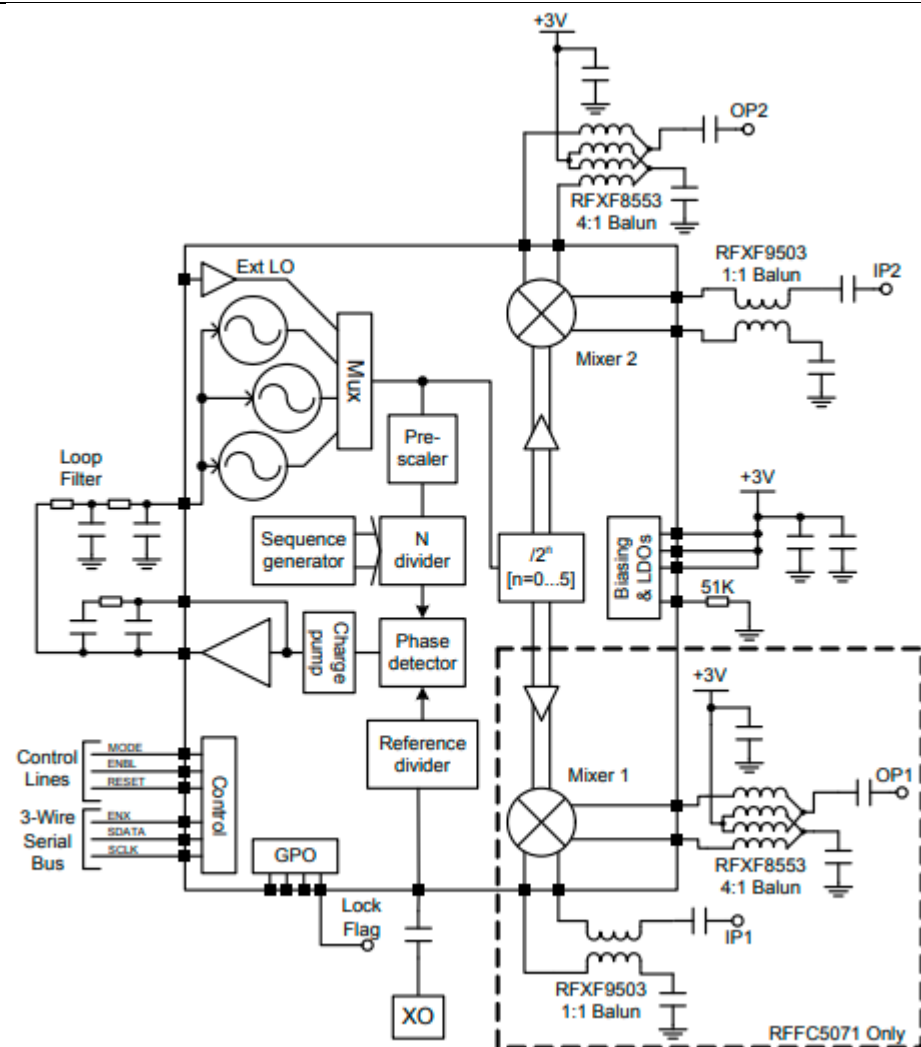
Instrumentalities performs at least substantially the same function in substantially the same way to achieve substantially the same result as the corresponding claim element.

To the extent the chart of an asserted claim relies on evidence about certain specifically identified Accused Instrumentalities, MEI asserts that, on information and belief, any similarly functioning instrumentalities also infringes the charted claim. MEI reserves the right to amend this infringement analysis based on other products made, used, sold, imported, or offered for sale by Qorvo. MEI also reserves the right to amend this infringement analysis by citing other claims of the '594 patent, not listed in the claim chart, that are infringed by the Accused Instrumentalities. MEI further reserves the right to amend this infringement analysis by adding, subtracting, or otherwise modifying content in the "Accused Instrumentalities" column of each chart.

**MICROELECTRONIC INNOVATIONS L.L.C'S INFRINGEMENT ANALYSIS**

| <b>'594 Patent<br/>Claim 1</b>                         | <b>Accused Instrumentalities<br/>Including Qorvo RFFC5072 Product</b>  |
|--|--|
| <b>1.pre.</b> A power amplification device comprising: | <p>The Accused Instrumentalities including, but not limited to, the exemplary RFFC5072 product, are 85-4200 MHz Wideband Synthesizer/VCO products with Integrated 6 GHz RF Mixer configured as a power amplification device, <i>see</i> below figures:</p> <p>Details on the Accused Instrumentalities, including the exemplary RFFC5072 product, are available on the Qorvo website, <a href="https://www.qorvo.com/products/p/RFFC5072">https://www.qorvo.com/products/p/RFFC5072</a>, including Integrated Synthesizer/Mixer Register Map Programming Guide <a href="https://www.qorvo.com/products/d/da000753">https://www.qorvo.com/products/d/da000753</a>, including the citation (Feedback Systems - An Introduction for Scientists and Engineers) <a href="https://people.duke.edu/~hpgavin/SystemID/References/Astrom-Feedback-2006.pdf">https://people.duke.edu/~hpgavin/SystemID/References/Astrom-Feedback-2006.pdf</a>, including Application Note: Integrated Synthesizer/Mixer Matching Circuits and Baluns <a href="https://www.qorvo.com/products/d/da000747">https://www.qorvo.com/products/d/da000747</a>, and the datasheet for the exemplary RFFC5072 product. <i>See, e.g.,</i> <a href="https://www.qorvo.com/products/d/da000735">https://www.qorvo.com/products/d/da000735</a></p> |

# MICROELECTRONIC INNOVATIONS L.L.C's INFRINGEMENT ANALYSIS

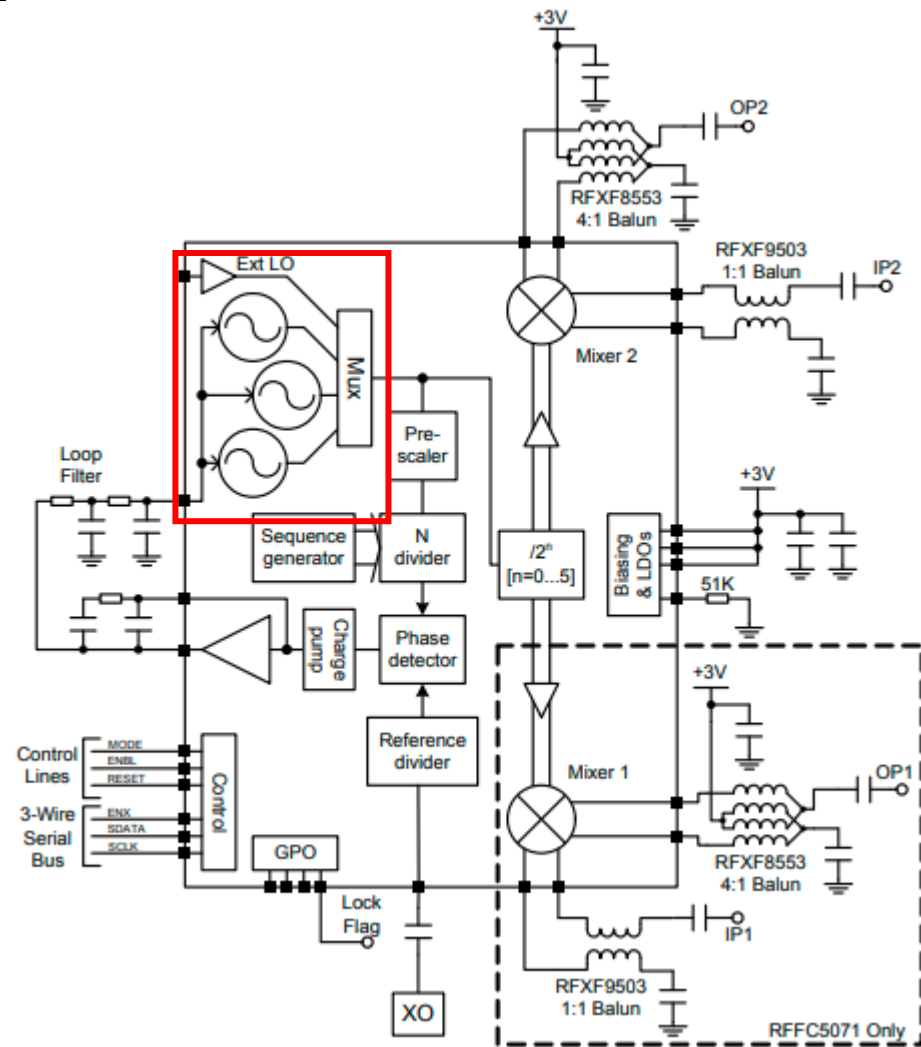


See, <https://www.qorvo.com/products/d/da000735> at 11.

## MICROELECTRONIC INNOVATIONS L.L.C'S INFRINGEMENT ANALYSIS

|  |   |
|--|---|
|  | <p>The RFFC5071 and RFFC5072 are re-configurable frequency conversion devices with integrated fractional-N phased locked loop (PLL) synthesizer, voltage controlled oscillator (VCO) and either one or two high linearity mixers. The fractional-N synthesizer takes advantage of an advanced sigma-delta modulator that delivers ultra-fine step sizes and low spurious products. The PLL/VCO engine combined with an external loop filter allows the user to generate local oscillator (LO) signals from 85MHz to 4200MHz. The LO signal is buffered and routed to the integrated RF mixers which are used to up/down-convert frequencies ranging from 30MHz to 6000MHz. The mixer bias current is programmable and can be reduced for applications requiring lower power consumption. Both devices can be configured to work</p> <p>See, <a href="https://www.qorvo.com/products/d/da000735">https://www.qorvo.com/products/d/da000735</a> at 1.</p> <p>To the extent any of the above-referenced claim language is construed or applied so that no literal infringement is found, MEI contends that this element is met under the doctrine of equivalents. The above-identified features and instrumentalities perform substantially the same function as the recited claim element, in substantially the same way, to achieve substantially the same result. Any differences are insubstantial.</p> <p>Specifically, the above-identified features perform substantially the same function in the same way as the recited claim element, namely a device having power amplification functionality.</p> |
| <p><b>1.a.</b> an <b>input</b> for receiving a signal having a desired frequency band, the signal also having a <b>transfer function</b> associated therewith;</p> | <p>The Accused Instrumentalities including, but not limited to, the exemplary RFFC5072 product, includes an input for receiving a signal having a desired frequency band (coming out from the VCO); the signal also has a transfer function associated therewith. See Figures below:</p>  |

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See, <https://www.qorvo.com/products/d/da000735> at 11.

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See, <https://www.qorvo.com/products/d/da000735> at 1.

The VCO core in the RFFC5071 and RFFC5072 consists of three VCOs which, in conjunction with the integrated LO dividers of /2 to /32, cover the LO range of 85MHz to 4200MHz. Each VCO has 128 overlapping bands which are used to achieve low VCO gain and optimal phase noise performance across the whole tuning range. The chip automatically selects the correct VCO (VCO auto-select) and VCO band (VCO coarse tuning) to generate the desired LO frequency based on the values programmed into the PLL1 and PLL2 registers banks.

The VCO auto-select and VCO coarse tuning are triggered every time ENBL is taken high, or if the PLL re-lock self clearing bit is programmed high. Once the correct VCO and band have been selected the PLL will lock onto the correct frequency. During the band selection process, fixed capacitance elements are progressively connected to the VCO resonant circuit until the VCO is oscillating approximately at the correct frequency. The output of this band selection, CT\_CAL, is made available in the read-

See, <https://www.qorvo.com/products/d/da000735> at 5.

The RFFC5071 and RFFC5072 contain a charge pump-based fractional-N phase locked loop (PLL) for controlling the three VCOs. The PLL includes automatic calibration systems to counteract the effects of process and environmental variations, ensuring repeatable loop response and phase noise performance. As well as the VCO auto-select and coarse tuning, there is a loop filter calibration mechanism which can be enabled if required. This operates by adjusting the charge pump current to maintain loop bandwidth. This can be useful for applications where the LO is tuned over a wide frequency range.

See, <https://www.qorvo.com/products/d/da000735> at 5.



## MICROELECTRONIC INNOVATIONS L.L.C'S INFRINGEMENT ANALYSIS

The formula (8.24) has a strong intuitive interpretation because it tells that the Laplace transform of the output is the product of the transfer function of the system and the transform of the input. In the transform domain the action of a linear system on the input is simply a multiplication with the transfer function. The transfer function is a natural generalization of the concept of gain of a system.

See, <https://people.duke.edu/~hpgavin/SystemID/References/Astrom-Feedback-2006.pdf> at 271.

| Parameter                                  | Specification |      |      | Unit | Condition                  |
|--|---------------|------|------|------|----------------------------|
|  | Min.          | Typ. | Max. |      |                            |
| Mixer 1/2 (Mixer output driving 4:1 balun) |               |      |      |      |                            |
| Gain                                       |               | -2   |      | dB   | Not including balun losses |
| Noise Figure <3000MHz                      |               | 10   |      | dB   | Low current setting        |
|  |               | 13   |      | dB   | High linearity setting     |
| Noise Figure <4000MHz                      |               | 11   |      | dB   | Low current setting        |
|  |               | 15   |      | dB   | High linearity setting     |

See, <https://www.qorvo.com/products/d/da000735> at 2.

| Parameter  | Specification |      |      | Unit | Condition                  |
|--|---------------|------|------|------|----------------------------|
|  | Min.          | Typ. | Max. |      |                            |
| Mixer 1/2 (Mixer output driving 4:1 balun) (continued) |               |      |      |      |                            |
| IIP3   |               | +10  |      | dBm  | Low current setting        |
|  |               | +23  |      | dBm  | High linearity setting     |
| Input Port Frequency range                             | 30            |      | 6000 | MHz  |                            |
| Mixer input return loss                                |               | 10   |      | dB   | 100Ω differential          |
| Output port frequency range                            | 30            |      | 4500 | MHz  |                            |
| Mixer 1/2 (Mixer output driving 1:1 balun)             |               |      |      |      |                            |
| Output Port Frequency Range                            | 30            |      | 6000 | MHz  |                            |
| Gain   |               | -7   |      | dB   | Not including balun losses |

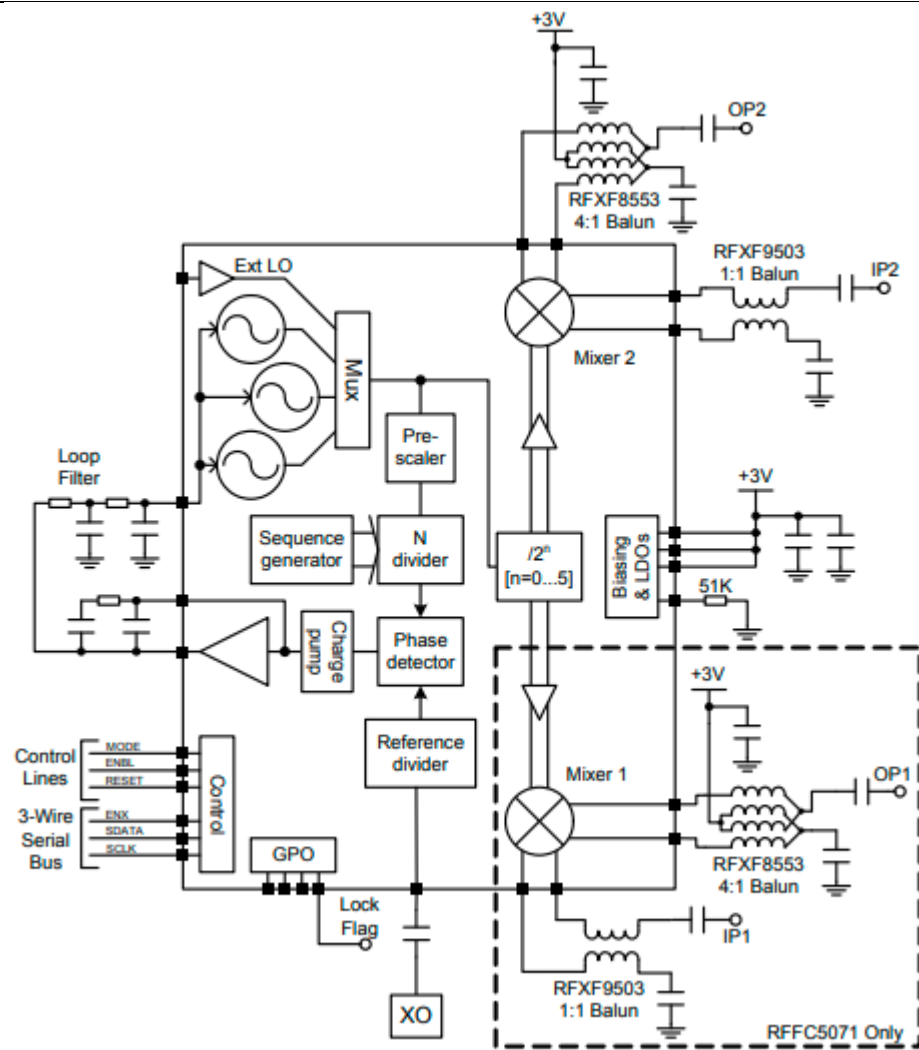
See, <https://www.qorvo.com/products/d/da000735> at 3.

As shown in the figures above, there are VCOs connected with the Phase detector, which is further connected with the loop filter and gives input as feedback to the VCOs to eliminate the errors further. Therefore, the input signal and the desired frequency band have a transfer function.

**MICROELECTRONIC INNOVATIONS L.L.C.'S INFRINGEMENT ANALYSIS**

|  |  |
|--|--|
|  | <p>To the extent any of the above-referenced claim language is construed or applied so that no literal infringement is found, MEI contends that this element is met under the doctrine of equivalents. The above-identified features and Accused Instrumentalities perform substantially the same function as the recited claim element, in substantially the same way, to achieve substantially the same result, and any differences are insubstantial.</p> <p>Specifically, the above-identified features perform substantially the same function in the same way as the recited claim element, namely an input for receiving a signal having a desired frequency band and having a transfer function.</p> |
| <p><b>1.b.</b> power amplification means of the delta-sigma type having an order greater than or equal to one; and</p> | <p>The Accused Instrumentalities including, but not limited to, the exemplary RFFC5072 product, include power amplification means of the delta-sigma type having an order greater than or equal to one. <i>See</i> figures below:</p>  |

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The RFFC5071 and RFFC5072 are re-configurable frequency conversion devices with integrated fractional-N phased locked loop (PLL) synthesizer, voltage controlled oscillator (VCO) and either one or two high linearity mixers. The fractional-N synthesizer takes advantage of an advanced sigma-delta modulator that delivers ultra-fine step sizes and low spurious products. The PLL/VCO engine combined with an external loop filter allows the user to generate local oscillator (LO) signals from 85MHz to 4200MHz. The LO signal is buffered and routed to the integrated RF mixers which are used to up/down-convert frequencies ranging from 30MHz to 6000MHz. The mixer bias current is programmable and can be reduced for applications requiring lower power consumption. Both devices can be configured to work

See, <https://www.qorvo.com/products/d/da000735> at 1.

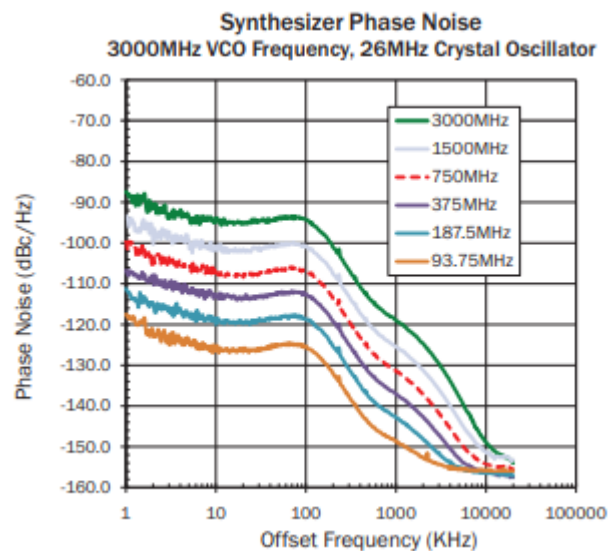
| Field Name | Bit Field | Function   |
|------------|-----------|--|
| fnz        | 15        | If programmed high the modulator to the fractional dividers is disabled. Test mode.  |
| dithr      | 14        | If high then the target frequency (reference of freq_det) is dither by the sigma delta   |
| sdm        | 13:12     | PLL sigma-delta modulator order: 00=first order accumulator, 01=2nd order MASH 1-1, 10=3rd order MASH 1-1-1 and 11=DSM modulator as defined by mode, dith, fm and dmode fields |

See, <https://www.qorvo.com/products/d/da000753> at 15.

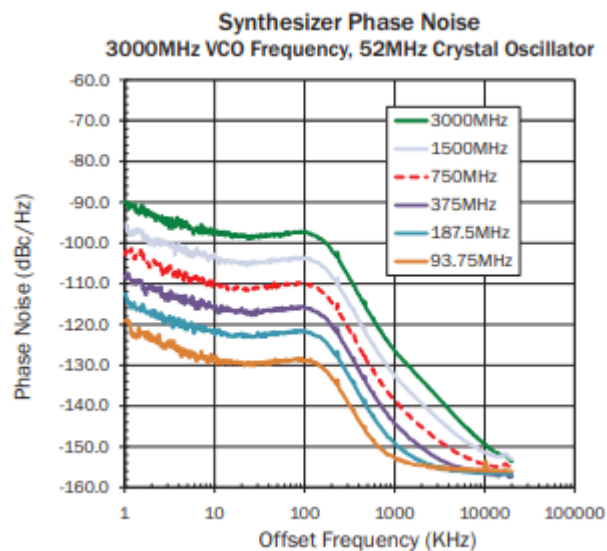
The RFFC5071 and RFFC5072 contain a charge pump-based fractional-N phase locked loop (PLL) for controlling the three VCOs. The PLL includes automatic calibration systems to counteract the effects of process and environmental variations, ensuring repeatable loop response and phase noise performance. As well as the VCO auto-select and coarse tuning, there is a loop filter calibration mechanism which can be enabled if required. This operates by adjusting the charge pump current to maintain loop bandwidth. This can be useful for applications where the LO is tuned over a wide frequency range.

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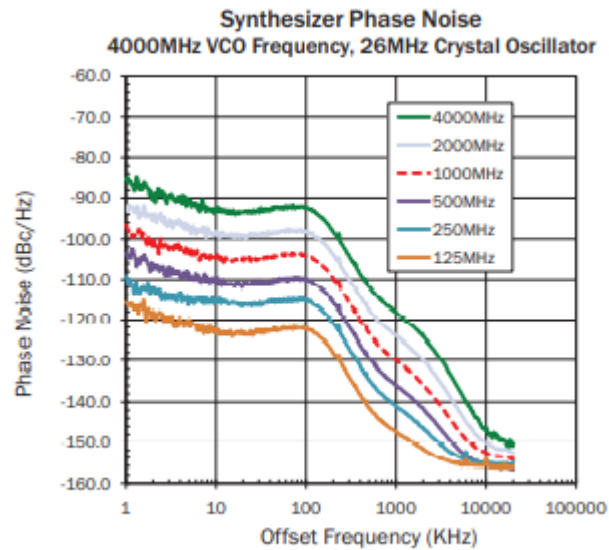


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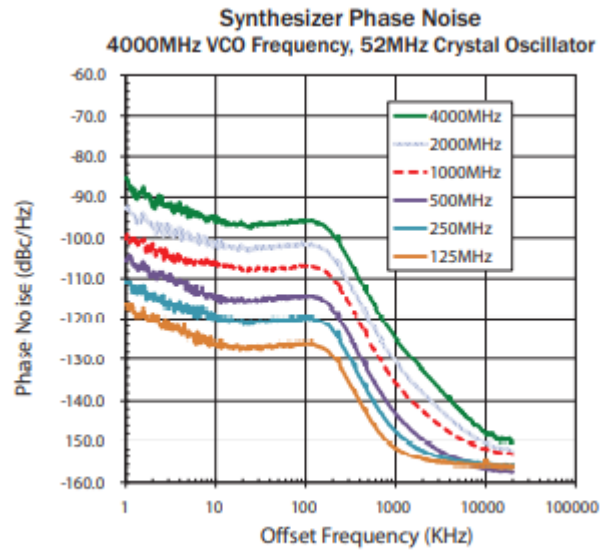
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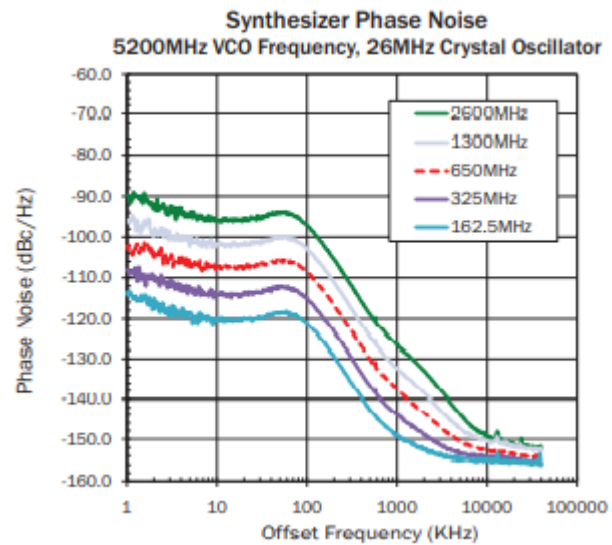
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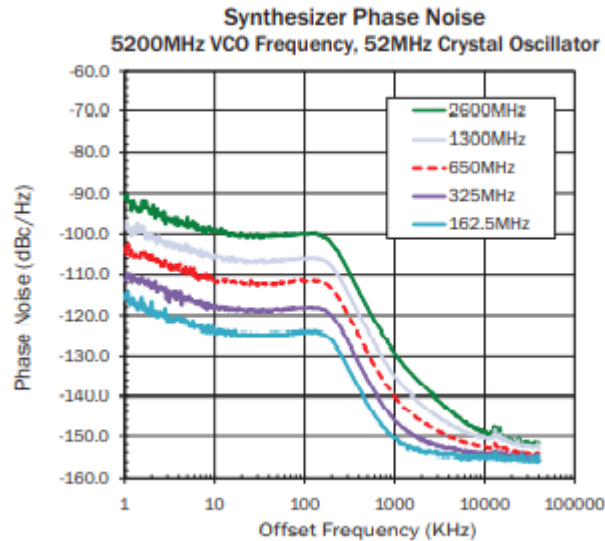
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See, <https://www.qorvo.com/products/d/da000735> at 15.

As shown in the figures above, the Accused Instrumentalities include a power amplification means of the delta-sigma type having an order greater than or equal to one.

To the extent any of the above-referenced claim language is construed or applied so that no literal infringement is found, MEI contends that this element is met under the doctrine of equivalents. The above-identified features and Accused Instrumentalities perform substantially the same function as the recited claim element, in substantially the same way, to achieve substantially the same result, and any differences are insubstantial.

Specifically, the above-identified features perform substantially the same function in the same way as the recited claim element, namely power amplification means of the delta-sigma type having an order greater than or equal to one.

**1.c. a plurality of signal amplifiers connected**

The Accused Instrumentalities including, but not limited to, the exemplary RFFC5072 product, include a plurality of signal amplifiers connected between the input and said power amplification means with each signal amplifier having a predetermined gain so that zeros of the transfer function are outside the desired frequency band. For example, the Accused Instrumentalities include, but are not limited to, the RFFC5072 product that includes fully integrated low Phase Noise VCO

## MICROELECTRONIC INNOVATIONS L.L.C'S INFRINGEMENT ANALYSIS

between the input and said power amplification means, each **signal amplifier** having a **predetermined gain** so that zeros of the transfer function are outside the desired frequency band.

and LO buffers which are responsible for giving optimal phase noise performance. *See* figures below:

### Features

- 85MHz to 4200MHz LO Frequency Range
- Fractional-N Synthesizer with Very Low Spurious Levels
- Typical Step Size 1.5Hz
- **Fully Integrated Low Phase Noise VCO and LO Buffers**

*See*, <https://www.qorvo.com/products/d/da000735> at 1.

### VCO

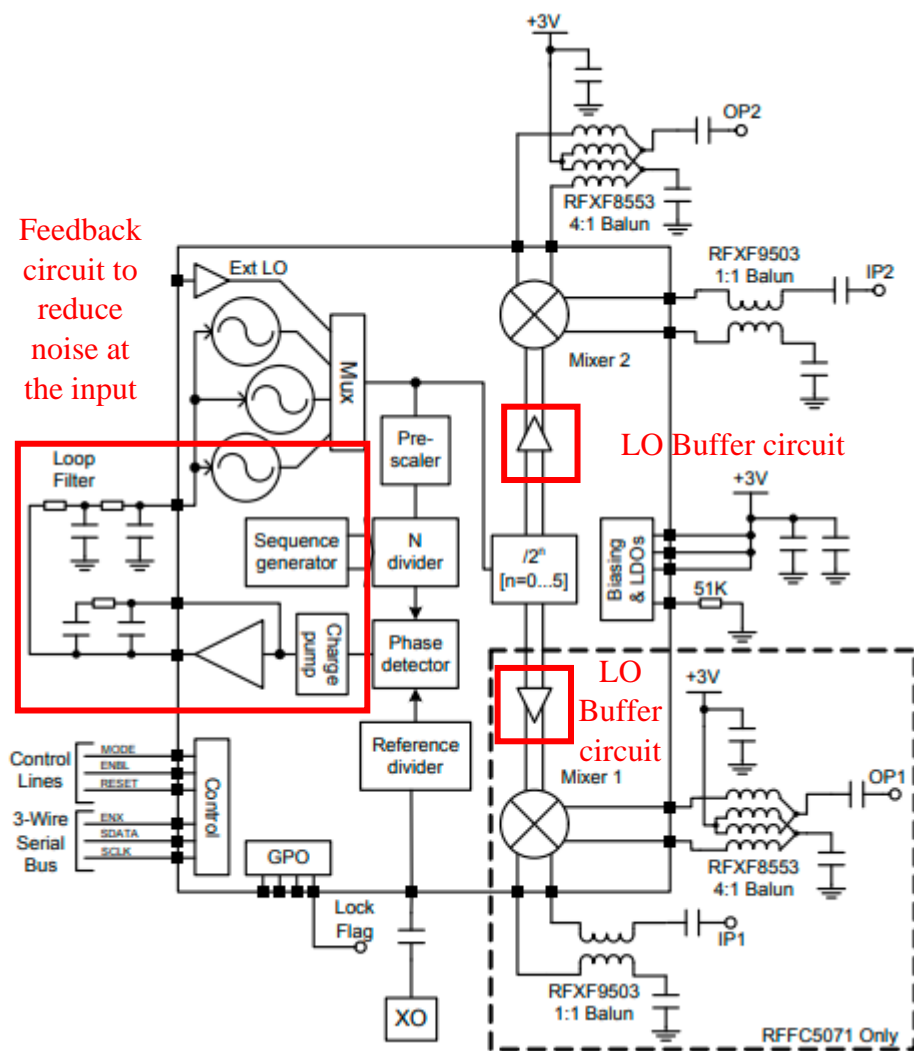
The VCO core in the RFFC5071 and RFFC5072 consists of three VCOs which, in conjunction with the integrated LO dividers of /2 to /32, cover the LO range of 85MHz to 4200MHz. Each VCO has 128 overlapping bands which are used to achieve low VCO gain and **optimal phase noise performance across the whole tuning range**. The chip automatically selects the correct VCO (VCO

*See*, <https://www.qorvo.com/products/d/da000735> at 5.

ultra-fine step sizes and low spurious products. **The PLL/VCO engine combined with an external loop filter allows the user to generate local oscillator (LO) signals from 85MHz to 4200MHz. The LO signal is buffered and routed to the integrated RF mixers which are used to up/down-convert frequencies ranging from 30MHz to 6000MHz. The mixer bias current is programmable and can be reduced for applications requiring lower power consumption.** Both devices can be configured to work

*See*, <https://www.qorvo.com/products/d/da000735> at 1.

## MICROELECTRONIC INNOVATIONS L.L.C's INFRINGEMENT ANALYSIS



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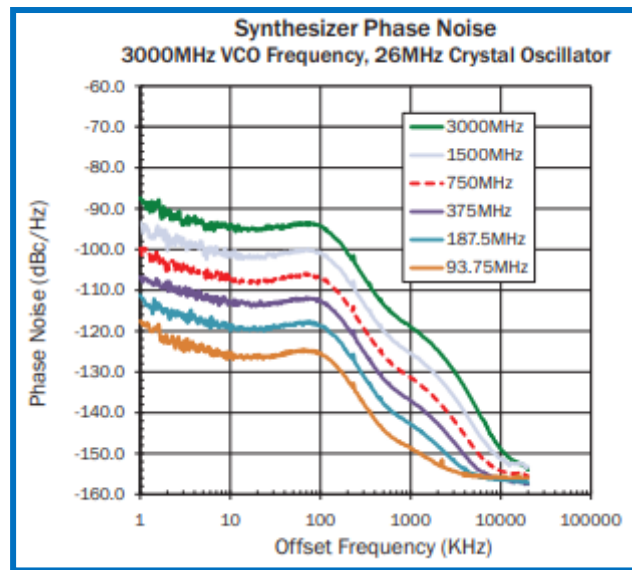
### Wideband Mixer

The mixers are wideband, double-balanced Gilbert cells. They support RF/IF frequencies from 30MHz up to 6000MHz. Each mixer has an input port and an output port that can be used for either IF or RF (in other words, for up- or down-conversion). The mixer current can be programmed to between about 15mA and 45mA depending on linearity requirements. The majority of the mixer current is sourced through the output pins via either a center-tapped balun or an RF choke in the external matching circuitry to the supply.

See, <https://www.qorvo.com/products/d/da000735> at 7.

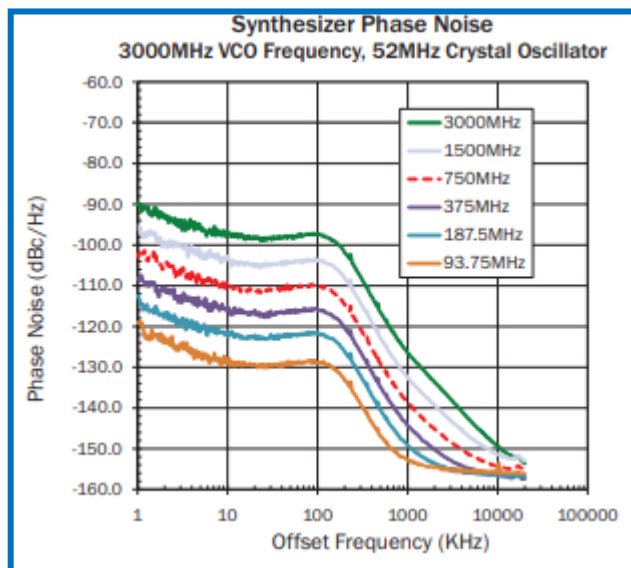
Because the mixers are double-balanced Gilbert cells, all of the ports are required to be balanced or differential. The mixer LO port is driven internally from balanced buffer amplifiers. For many applications the mixer input and outputs may be connected directly, via suitable matching, to balanced components. These may be SAW filters, LNAs, or IF amplifiers. For applications where the mixer will be connected to

See, <https://www.qorvo.com/products/d/da000747> at 4.



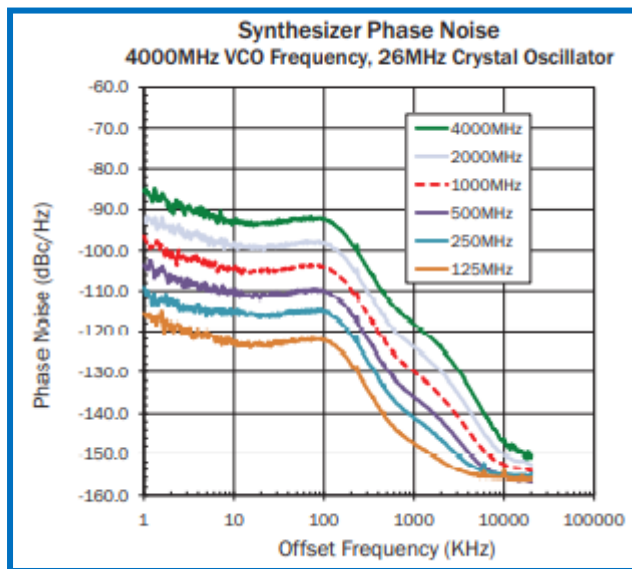
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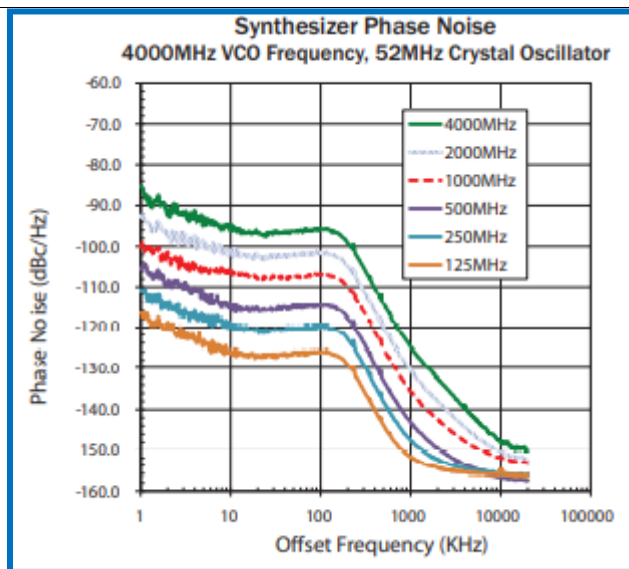
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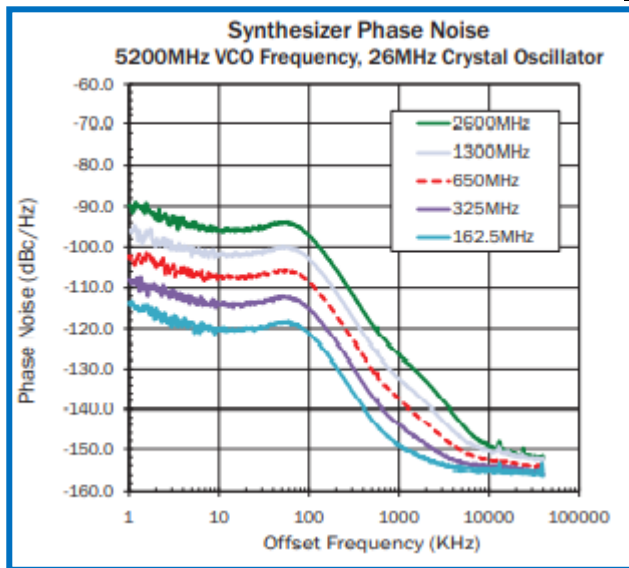
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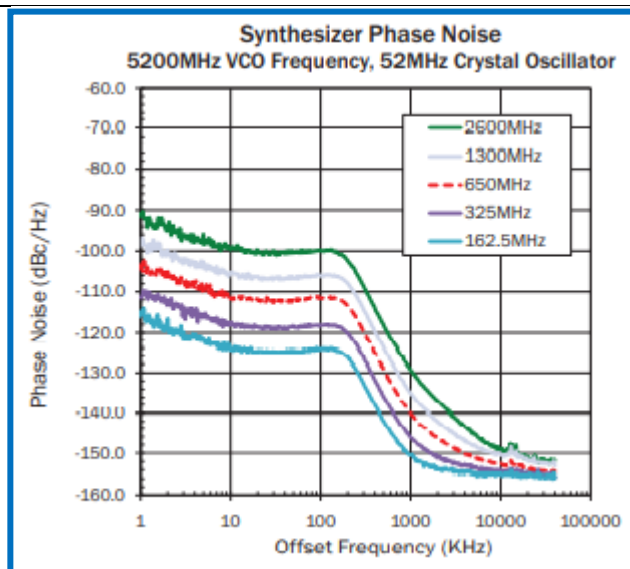
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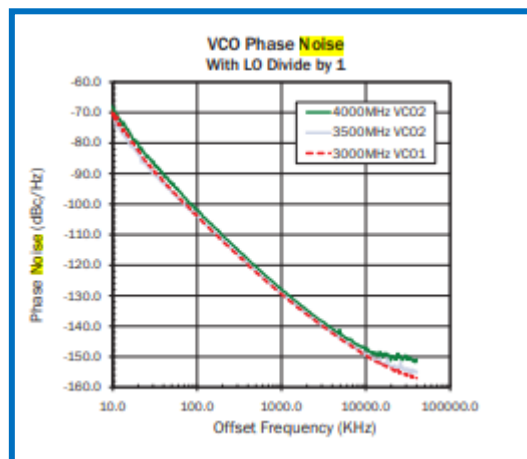
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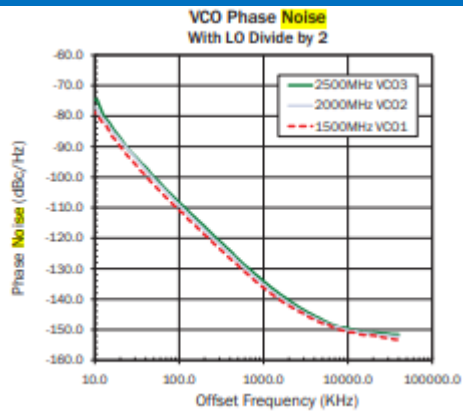


See, <https://www.qorvo.com/products/d/da000735> at 15.



See, <https://www.qorvo.com/products/d/da000735> at 16.

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See, <https://www.gorvo.com/products/d/da000735> at 16.

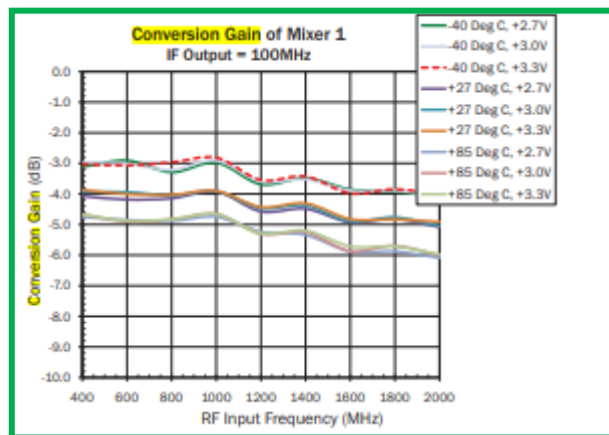
| Parameter                                  | Specimication |      |      | Unit | Condition                  |
|--|---------------|------|------|------|----------------------------|
|  | Min.          | Typ. | Max. |      |                            |
| Mixer 1/2 (Mixer output driving 4:1 balun) |               |      |      |      |                            |
| Gain                                       |               | -2   |      | dB   | Not including balun losses |
| Noise Figure <3000MHz                      |               | 10   |      | dB   | Low current setting        |
|  |               | 13   |      | dB   | High linearity setting     |
| Noise Figure <4000MHz                      |               | 11   |      | dB   | Low current setting        |
|  |               | 15   |      | dB   | High linearity setting     |

See, <https://www.gorvo.com/products/d/da000735> at 2.

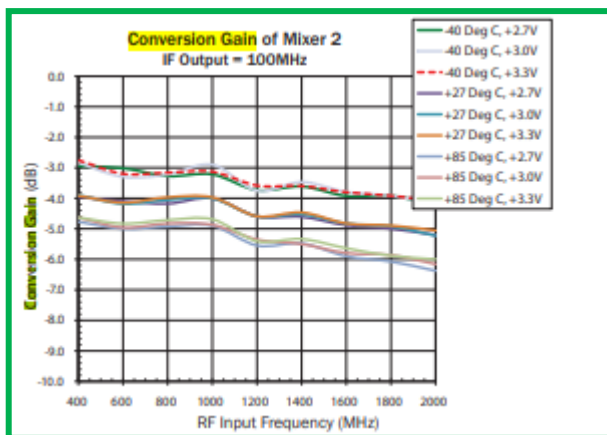
| Parameter  | Specification |      |      | Unit | Condition                  |
|--|---------------|------|------|------|----------------------------|
|  | Min.          | Typ. | Max. |      |                            |
| Mixer 1/2 (Mixer output driving 4:1 balun) (continued) |               |      |      |      |                            |
| IIP3   |               | +10  |      | dBm  | Low current setting        |
|  |               | +23  |      | dBm  | High linearity setting     |
| Input Port Frequency range                             | 30            |      | 6000 | MHz  |                            |
| Mixer input return loss                                |               | 10   |      | dB   | 100Q differential          |
| Output port frequency range                            | 30            |      | 4500 | MHz  |                            |
| Mixer 1/2 (Mixer output driving 1:1 balun)             |               |      |      |      |                            |
| Output Port Frequency Range                            | 30            |      | 6000 | MHz  |                            |
| Gain   |               | -7   |      | dB   | Not including balun losses |

## MICROELECTRONIC INNOVATIONS L.L.C's INFRINGEMENT ANALYSIS

See, <https://www.qorvo.com/products/d/da000735> at 3.

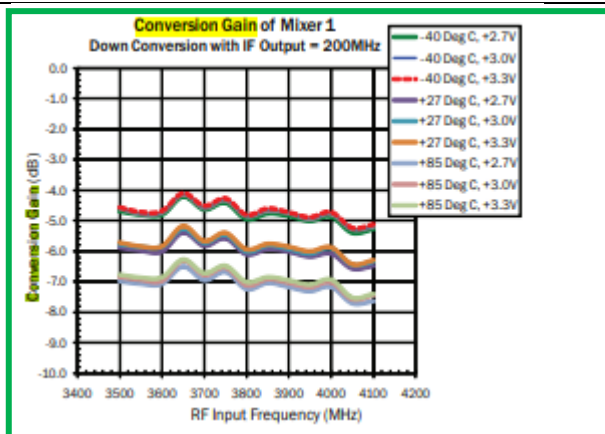


See, <https://www.qorvo.com/products/d/da000735> at 20.

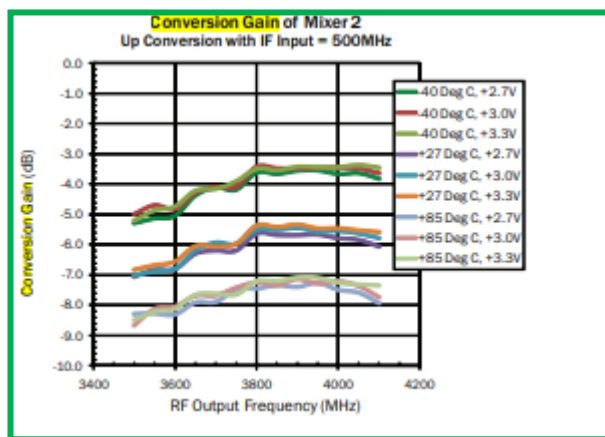


See, <https://www.qorvo.com/products/d/da000735> at 21.

## MICROELECTRONIC INNOVATIONS L.L.C's INFRINGEMENT ANALYSIS

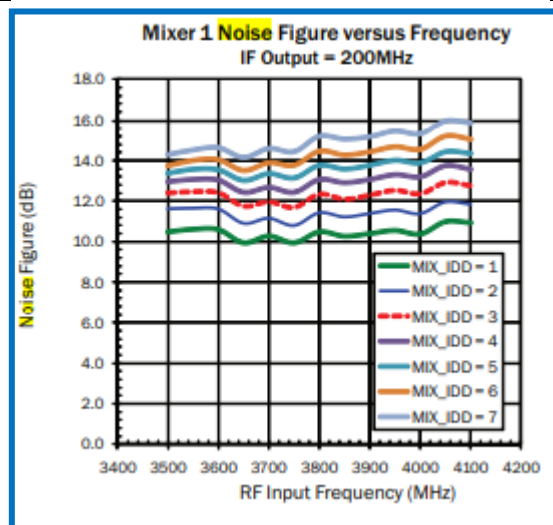


See, <https://www.qorvo.com/products/d/da000735> at 23.

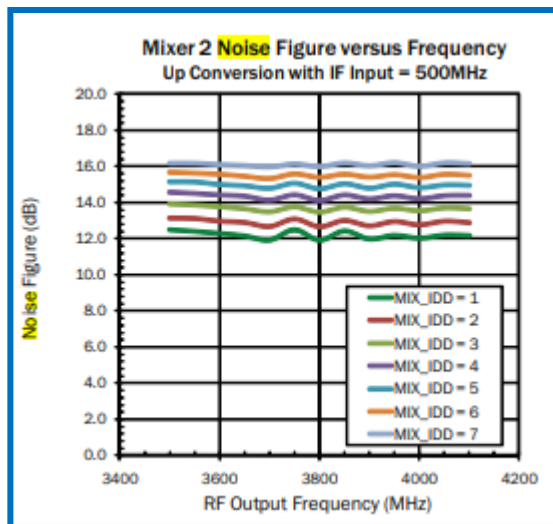


See, <https://www.qorvo.com/products/d/da000735> at 24.

## MICROELECTRONIC INNOVATIONS L.L.C's INFRINGEMENT ANALYSIS



See, <https://www.qorvo.com/products/d/da000735> at 23.



See, <https://www.qorvo.com/products/d/da000735> at 24.

### MICROELECTRONIC INNOVATIONS L.L.C'S INFRINGEMENT ANALYSIS

According to the figures above, the presence of high linearity settings in mixers shows the plurality of the signal amplifiers (LO Buffer circuits) having a predetermined gain (set transfer function) so that the zeros of the transfer function are outside the frequency band.

To the extent any of the above-referenced claim language is construed or applied so that no literal infringement is found, MEI contends that this element is met under the doctrine of equivalents. The above-identified features and instrumentalities perform substantially the same function as the recited claim element, in substantially the same way, to achieve substantially the same result. Any differences are insubstantial.

Specifically, the above-identified features perform substantially the same function in the same way as the recited claim element, namely a plurality of signal amplifiers connected between the input and said power amplification means, each signal amplifier having a predetermined gain so that zeros of the transfer function are outside the desired frequency band.

**Caveat:** The notes and/or cited excerpts utilized herein are set forth for illustrative purposes only and are not meant to be limiting in any manner. For example, the notes and/or cited excerpts, may or may not be supplemented or substituted with different excerpt(s) of the relevant reference(s), as appropriate. Further, to the extent any error(s) and/or omission(s) exist herein, all rights are reserved to correct the same.